Grounded cognition

Language as a cognitive tool

Igor Farkaš
Centre for Cognitive Science
Faculty of Mathematics, Physics and Informatics
Comenius University in Bratislava

Mirolli & Parisi: Towards a Vygotskyan cognitive robotics: The role of language as a cognitive tool. New Ideas in Psychology 29 (2011) 298–311

Introduction

- Approaches in science: analytic, synthetic
- Cognitive robotics:
  - robots as research tools for studying cognition;
  - robots for studying 'truly cognitive' phenomena, in contrast with 'mere' sensory-motor interactions with the environment.
- continuum between low-level and high-level cognitive functions
- a theoretical shift from symbol-manipulation paradigm to the sub-symbolic, embodied, situated, and distributed approaches to cognition

Social development theory

- Lev Vygotsky:
  - social learning tends to precede development
  - language develops from social interaction to communication purposes → linguistically-mediated social interactions
- two roles of language in cognitive development:
  1) main means by which adults transmit information to children
  2) powerful tool of intellectual adaptation
- process of internalization → "private speech"
- Language causes a radical transformation of elementary cognitive abilities into the high-level, specifically human, psychological functions.

Language as a cognitive tool

- the most promising way of addressing high-level specifically human cognitive capacities is to develop a Vygotskyan cognitive robotics (→ two meanings of "cognitive robotics")
- Co-evolution of linguistic and non-linguistic abilities in hominids has most probably led to significant differences between human and non-human non-linguistic cognition, in contrast with what Vygotsky appears to have assumed (Parisi, 2007).
- → Importance of language for robots

Language aids cognitive processes

- Learning
- Categorization
- Abstraction
- Memory
- Voluntary control
- Mental life
- empirical and computational support

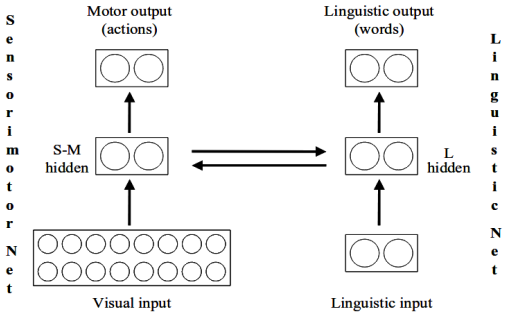
Learning

- Empirical evidence: Linguistic input (labels) can substantially ease and speed up the learning process of object categorization
- Computational support: category learning, language-game models, artificial-life simulations
- Two mechanisms proposed:
  - linguistic inputs help focus learner's attention to the specific aspects of perception that are relevant for categorization,
  - language can sometimes represent the principal (or even the only) ground on which the learner can develop the discriminative capacities that constitute categorization

Categorization

- language does not only facilitate category learning ...
- … it can also improve categorization once categories have already been learned.
- Support from connectionist modeling (Mirolli & Parisi, 2005):

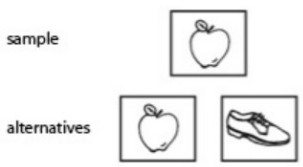
- Model demonstrates that learning the mapping between pre-linguistically learned concepts and linguistic labels changes the internal representations of objects.



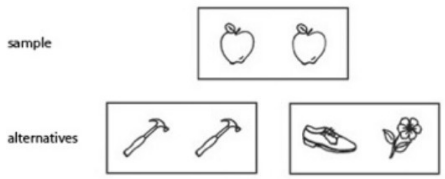
Abstraction

- Categorization requires abstraction
- Hierarchical organization
- Experiments with children (Gentner et al) – spatial relations
- Experiments with chimps (Thompson et al) – sameness/difference

A match to sample problem:



relation b/w objects



relation b/w relations